



## ASSESSMENT OF THE ESTUARY AND NORTHERN GULF OF ST. LAWRENCE (AREAS 13 TO 17, 12A, 12B, 12C AND 16A) SNOW CRAB STOCKS IN 2013



Image: Snow Crab

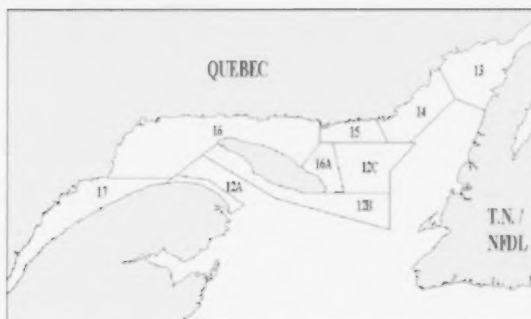


Figure 1. Snow Crab management areas in the Estuary and the northern Gulf of St. Lawrence.

### Context

The Snow Crab fishery in the Estuary and the northern Gulf of St. Lawrence began in the late 1960s. The fishery experienced a boom from 1979 to 1985 and a management approach based on the TAC (total allowable catch) was gradually introduced between 1985 and 1995. There are nine management areas (13 to 17, 16A, 12A, 12B and 12C) (Figure 1).

Landings have varied depending on the adjusted TACs based on the recruitment waves and troughs that have affected the fishery (Figure 2), with maximum levels recorded in 1995 (7 879 t) and 2002 (10 372 t). Landings dropped considerably in 2003 owing to the lower TACs established in response to signs of overfishing, mainly in Area 16. Landings totalled 9 078 t in 2013.

The fishery targets only males with a carapace width  $\geq 95$  mm. White crab (crab that has recently moulted) and adolescent males may be returned to the water during the fishing season to enhance their meat yield and give them a chance to reproduce. Furthermore, since 1985, when the proportion of white crab in catches at sea exceeds 20%, the fishery in the area concerned is automatically closed to minimize the mortality of these very fragile crabs, which will be available to the fishery the following year.

The DFO Fisheries and Aquaculture Management Branch, Quebec Region, requested a resource status assessment, as well as scientific advice, in order to set the 2014 quotas. A scientific peer review was conducted on February 17 and 18, 2014. Participants included representatives from DFO Science and Fisheries and Aquaculture Management, the fishing industry, provincial governments and First Nations.

## SUMMARY

- In 2013, stocks in the Middle and Lower North Shore of the Gulf of St. Lawrence (Areas 13, 14, 15, 16, 16A and 12C) and south of Anticosti Island (Area 12B) had high commercial biomass. Recruitment and abundance of adolescent crabs  $\geq 78$  mm near or above the average suggest that this biomass will be maintained in the short term. Conversely, the Estuary stock (Area 17) was characterized by a declining commercial biomass. The only biomass index for the stock on the north shore of the Gaspé Peninsula (Area 12A), that is, the catch rate during the 2013 fishery, suggests that the resource is abundant in this area.
- The purpose of conservation is to maintain an adequate male reproductive biomass in order to ensure the recovery or maintenance of the population in a given area. Recommendations assume that the natural mortality rate will be the same in 2014 as in previous years.

## Recommendations:

- In Area 17, a 20% decrease in catches compared to those in 2013 is recommended to avoid creating an excessively high harvesting intensity and to reduce the potential impact of the fishery on white crab.
- In Area 16, for 2014, an increase in catches of 15% to 20% over those in 2013 would not result in an excessively high harvesting intensity.
- In Area 15, for 2014, catches comparable to those of 2013 would not result in an excessively high harvesting intensity.
- In Area 14, a maximum 35% increase in catches in 2014 over those in 2013 would not result in an excessively high harvesting intensity.
- In Area 13, a maximum 25% increase in catches in 2014 over the total authorized in 2013 would not result in an excessively high harvesting intensity.
- In Area 12A, based on the commercial catch rate, a maximum 10% increase in catches in 2014 over those in 2013 would not result in an excessively high harvesting intensity.
- In Area 12B, for 2014, a 20% to 25% increase in catches over those in 2013 would not result in an excessively high harvesting intensity.
- In Area 12C, for 2014, catches equal to or 10% lower than those in 2013 would not result in an excessively high harvesting intensity.
- In Area 16A, for 2014, catches comparable to those in 2013 would not result in an excessively high harvesting intensity.

## INTRODUCTION

### Species biology

In Canada, Snow Crab can be found from the southern tip of Nova Scotia to halfway up the Labrador coast, as well as in the Estuary and Gulf of St. Lawrence. In the Gulf of St. Lawrence, commercial-size males live at depths ranging from 60 m to 220 m, except during their moulting and reproductive periods, during which they migrate to shallower waters. The Snow Crab stops growing after the terminal moult. Males are considered adolescents (small claws) prior to the terminal moult and adults (large claws) afterward. Male carapace width (CW) ranges from 40 mm to 165 mm after the terminal moult. If they do not undergo their terminal moult earlier, males reach legal size (95 mm CW) at about nine years of age. Snow Crab recruitment is periodic or episodic and varies considerably over an 8- to 12-year cycle. The entry of recruits into the fishery can be determined by regular monitoring of landings (carapace size and

condition) and the catch rate (catch per unit effort, CPUE), and is confirmed by scientific trap and trawl surveys.

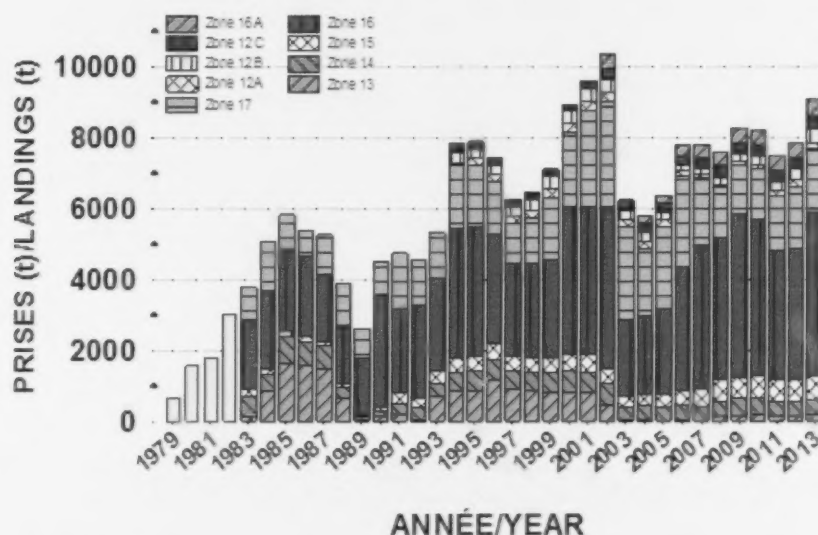


Figure 2. Snow Crab landings in the Estuary and northern Gulf of St. Lawrence. From 1979 to 1982, landings were not differentiated by area.

## ASSESSMENT OF THE RESOURCE

Analyses of all areas are based on fishing data from logbooks, processing plant purchase slips and dockside weighing summaries, along with catch sampling data obtained from the Observers Program and DFO samplers. In 2013, the industry conducted a trap-based research survey in all fishing areas except Area 12A, and the findings were incorporated into the stock status analyses. These surveys help determine the mean numbers per unit effort (NUE) of legal-size crabs by area and the NUE of adolescent crabs with carapaces over 78 mm wide that will reach or exceed legal size during the next moult. In Area 17, the catch of adolescent crabs from the experimental traps, which have a smaller mesh (15 mm when stretched), during the post-season survey was also examined to obtain an early indication of the strength of the cohorts that would reach the legal size. The results of the trawl research surveys conducted in 2012 and 2013 in Areas 13 and 17 were used to calculate a juvenile and adult crab abundance index.

The fishery's raw catches per unit effort (CPUE) were standardized using an additive model to account for seasonal changes, gear type, soak time and fishing site. The proportion of recruits (or new crabs), which can be identified by their new carapace (carapace conditions 1 and 2), was determined by dockside samplers.

A combined index was developed to obtain a better estimate of the short-term commercial biomass trend and help increase the consistency of the interannual recommendations for a given stock. This index is based on the two biomass indices, that is, the post-season NUE for adult males  $\geq 95$  mm and the standardized commercial CPUE. The combined index is the average of these two indices, after they have each been standardized based on the average for a reference period (2000 to 2012).

Data on the size structure of crabs sampled at sea, dockside and during trap surveys were also used.

To date, data on female insemination levels have been collected sporadically in certain areas. Annual systematic sampling of each area is recommended so this parameter can be used for stock status assessments because it is a measure of primiparous female mating success and the relative abundance of large adult males (Sainte-Marie et al. 2002, 2008).

## Area 17

### Description of the fishery

In Area 17, there are 22 fishers who hold regular licences in group A (88% of the TAC), 22 fishers who hold special licences and 2 beneficiaries of temporary allocations in group B (12% of the TAC). After being rather low at 1 430 t from 2008 to 2010, the TAC increased by 26% between 2010 and 2012 and remained unchanged at 1 809 t in 2013 (Figure 3). The fishing season opened on March 26 and closed on June 20. The TAC was reached.

### Resource status in 2013

In the commercial fishery, the standardized CPUE remained high from 2000 to 2004, then decreased by nearly 50% between 2004 and 2008 (Figure 4). It trended upward from 2009 to 2011, then decreased until 2013 to below average. Landings were dominated by recruits (new crabs, carapace conditions 1 and 2) from 2007 to 2009 and have been dominated by intermediate-shell crabs (condition 3) since 2010. The proportion of old crabs (conditions 4 and 5) remained low and stable (Figure 5). The average size of legal-size crabs caught at sea was slightly above average from 2007 to 2010 and well above average at 113 mm from 2011 to 2013 (Figure 6).

The trap-based research survey, a data series that began in 1996 on the north shore and in 1999 on the south shore, indicates that the NUE of adults  $\geq 95$  mm decreased by more than 50% from 2005 to 2007 and remained below average, dropping to one of the lowest values in the series in 2013 (Figure 7). The number of crabs left by the fishery, i.e., intermediate-shell and old crabs (conditions 3, 4 and 5) followed a similar trend and sharply decreased in 2013. The number of recruits (conditions 1 and 2) remained near average from 2005 to 2008 and then reached very high levels in 2009 and 2010 (Figure 8) before decreasing sharply for two consecutive years to well below average in 2012 and 2013. There will likely be less biomass available to the fishery at the beginning of the 2014 season than there was in 2013, and it will largely consist of intermediate-shell and old crabs. After reaching the highest value of the series in 2009, the number of adolescents  $\geq 78$  mm caught in traps decreased significantly until 2012 and remained stable in 2013 at a value well below average (Figure 8). However, an examination of the catch from the traps with a smaller mesh (experimental traps) showed a larger number of adolescent crabs that could reach the legal size of 95 mm in 2014, suggesting higher recruitment to the fishery in the medium term. The average size of legal-size adult crabs decreased during the 2013 post-season survey, suggesting that it will do likewise during the 2014 commercial catch.

The combined index of commercial CPUE and of NUE in the post-season survey decreased in 2013 and is low. This index suggests that there will be less biomass available to the fishery in 2014 than there was in 2013.

Results from the trawl survey conducted on the north shore of the Estuary in 2013 show that the abundance of adolescents between 78 mm and 95 mm increased after 2011, but remained low at 11.6 crabs/10 000 m<sup>2</sup>. The abundance of adolescents between 62 mm and 78 mm increased slightly, reaching the highest value since 2002 or 29 crabs/10 000 m<sup>2</sup>. The abundance of males between 40 mm and 62 mm, which was very high in 2011, decreased, but remained high in 2013 at 85 crabs/10 000 m<sup>2</sup>, whereas the abundance of males less than 40 mm decreased to 80 crabs/10 000 m<sup>2</sup> in 2013 after peaking at 350 crabs/10 000 m<sup>2</sup> in 2011. A review of size frequencies



shows a lower density of immature females between 20 mm and 55 mm in 2013 than in 2011, indicating that primiparous females will be less abundant in the short and medium term.

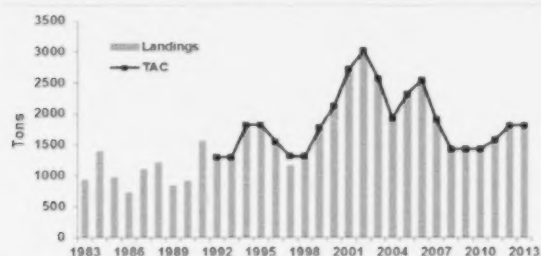


Figure 3. Landings and TAC in Area 17 from 1983 to 2013.

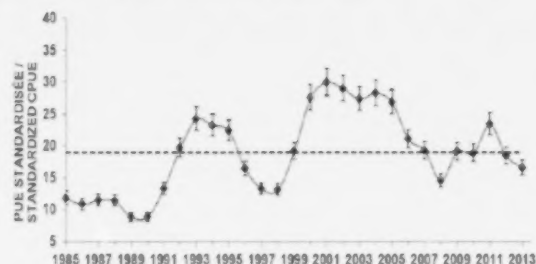


Figure 4. Standardized CPUE  $\pm$  confidence interval in the commercial fishery from 1985 to 2013 in Area 17. The dotted line shows the data series average.

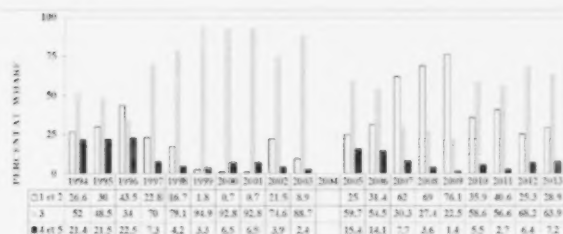


Figure 5. Carapace conditions for commercial crabs landed in Area 17 from 1994 to 2013.

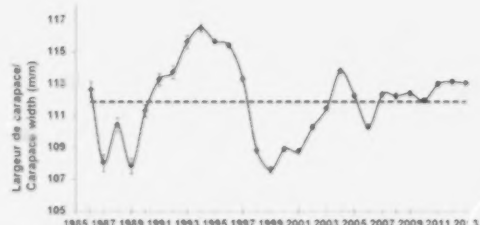


Figure 6. Average carapace width  $\pm$  confidence interval for commercial-size crabs sampled at sea from 1986 to 2013 in Area 17. The dotted line shows the data series average.

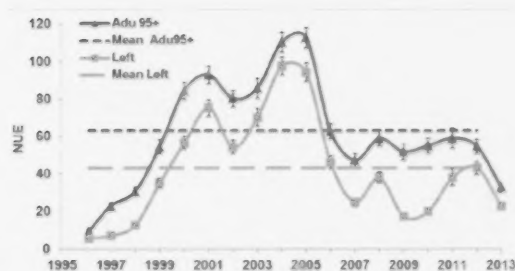


Figure 7. Catch rates (NUE), with confidence interval and average, of adult crabs  $\geq 95$  mm and those left by the fishery, from the post-season survey in Area 17 from 1996 to 2013.

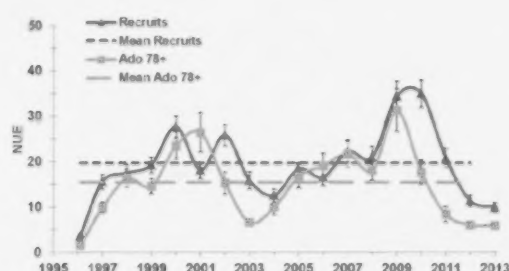


Figure 8. Catch rates (NUE), with confidence interval and average, of adolescent crabs  $\geq 78$  mm and recruits from the post-season survey in Area 17 from 1996 to 2013.

In 2013, the average amount of sperm stored in the females' spermathecae was low, indicating a sex ratio imbalance favouring females.

### Conclusion and advice

The TAC remained stable between 2012 and 2013 at 1 809 t, and was reached.

The catch rate during the 2013 commercial fishery decreased and was slightly below average. Landings consisted primarily of intermediate-shell crabs.

The post-season survey suggests that the biomass available to the fishery in 2014 will be lower than it was in 2013 and that the catches will consist largely of intermediate-shell and old crabs.

The combined index of commercial CPUE and of NUE from the post-season survey fell and is low.

The size of crabs caught in the commercial fishery has remained stable and high since 2011, but it should decrease in 2014 according to the post-season survey.

The 2013 post-season survey indicates an abundance of adolescents  $\geq 78$  mm and low recruitment. However, the results from the experimental traps suggest an increase in the number of crabs that will reach the legal size in 2014 after the spring moult.

The drop in the combined index suggests that catches should be decreased to avoid creating an excessively high harvesting intensity.

### **Recommendation**

A 20% decrease in catches compared to 2013 is recommended to avoid creating an excessively high harvesting intensity and to reduce the potential impact of the fishery on white crab.

## **Area 16**

### **Description of the fishery**

In Area 16, there are 38 fishers who hold regular Snow Crab licences in group A (92.7% of the TAC) and 16 who hold special licences in group B (7.3% of the TAC). After peaking at 4 606 t in 2009 and 2010, the TAC decreased to 3 686 t in 2011 and 2012 and then increased by 25% in 2013 to peak again at 4 606 t (Figure 9). The fishing season opened on April 1 and closed on July 7. The TAC was reached.

### **Resource status in 2013**

**In the commercial fishery**, the standardized CPUE, which remained slightly above average in 2008 and 2009, decreased significantly in 2010 before increasing for three consecutive years to well above average in 2013 (Figure 10). Landings since 2006 (Figure 11) have consisted primarily of recruits (carapace conditions 1 and 2) and very few old crabs (conditions 4 and 5). This could have been caused by high fishing pressure at the outset of the period, which was recently followed by high recruitment to the fishery. The average size of legal-size crabs caught at sea has increased since the historic trough of 2002 and remained at or above average since 2006. In 2013, it was 111.4 mm (Figure 12).

**The trap-based research survey**, conducted every fall since 1994, shows that the NUE of adults  $\geq 95$  mm increased in 2011, after having trended downward from 2007 to 2010, and reached the highest value in the historical series in 2013 (Figure 13). The number of intermediate-shell and old crabs (conditions 3, 4 and 5), that is, those left by the fishery, was near average in 2011 and 2012 and then also increased in 2013 to the highest value in the series (Figure 13). The number of recruits (conditions 1 and 2) has been above average since 2007 and has been very high since 2011 (Figure 14). More biomass should therefore be available to the fishery at the beginning of the 2014 season than in 2013, and will likely largely consist of intermediate-shell crabs. The average NUE of adolescents  $\geq 78$  mm has been well above average since 2007 (Figure 14), which suggests that good recruitment will be maintained in the short term. During the survey, the average size of adult crabs  $\geq 95$  mm only increased very slightly between 2012 and 2013, suggesting that there will be no change in commercial catches in 2014 compared to 2013.

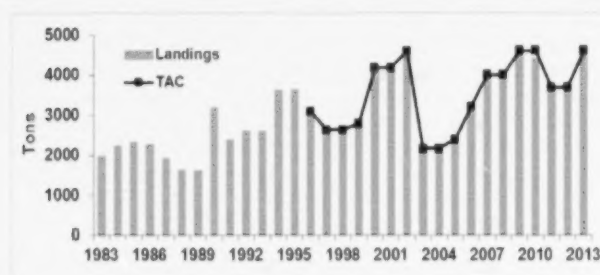


Figure 9. Landings and TAC in Area 16 from 1983 to 2013.

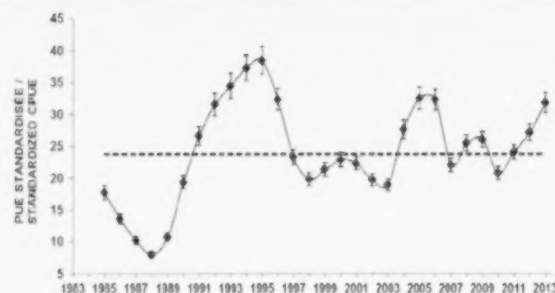


Figure 10. Standardized CPUE  $\pm$  confidence interval in the commercial fishery from 1985 to 2013 in Area 16. The dotted line shows the data series average.

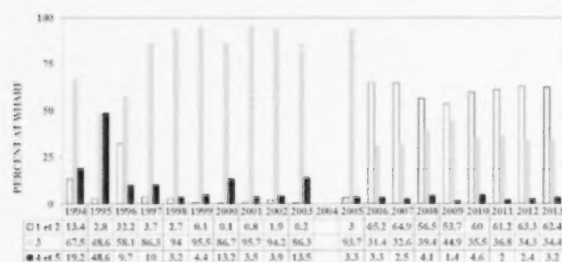


Figure 11. Carapace conditions for commercial crabs landed in Area 16 from 1994 to 2013.

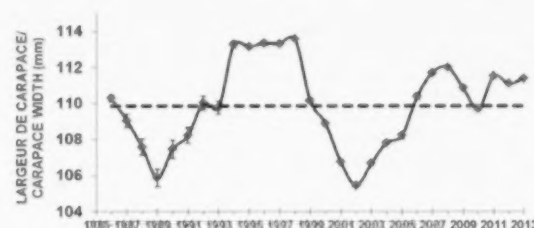


Figure 12. Average carapace width  $\pm$  confidence interval for commercial-size crabs sampled at sea from 1986 to 2013 in Area 16. The dotted line shows the data series average.

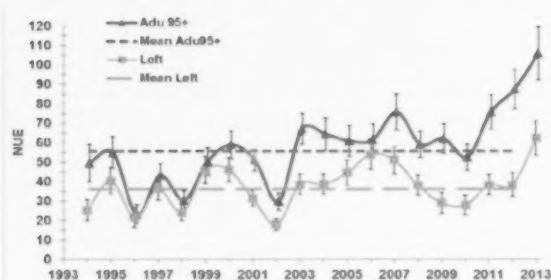


Figure 13. Catch rates (NUE), with confidence interval and average, of adult crabs  $\geq 95$  mm and those left by the fishery, from the post-season survey in Area 16 from 1994 to 2013.

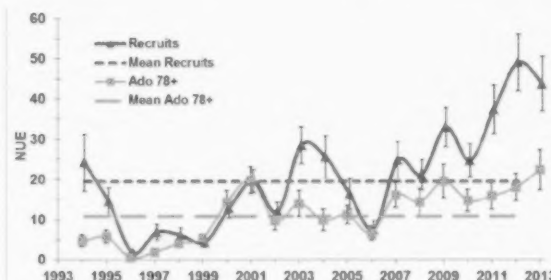


Figure 14. Catch rates (NUE), with confidence interval and average, of adolescent crabs  $\geq 78$  mm and recruits from the post-season survey in Area 16 from 1994 to 2013.

The combined index of commercial CPUE and of NUE from the post-season survey increased to a historic high in 2013. This index suggests that there will be more biomass available to the fishery in 2014 than there was in 2013.

Results from the trawl survey conducted every year in Sainte-Marguerite Bay near Sept-Îles show a commercial-size recruitment wave consistent with the post-season survey observations. This recruitment wave should help maintain a large commercial biomass in the short term. However, the

results also indicate a decrease in the abundance of crabs less than 78 mm, which implies the beginning of a commercial biomass decline in the medium term.

The *spermathecae* of primiparous females from Sainte-Marguerite Bay contained more sperm in 2012 and 2013 than in the previous three years, indicating a relatively greater availability of large males.

### Conclusion and advice

The TAC increased by 25% to 4 606 t between 2012 and 2013 and was reached.

The catch rate increased to well above average during the 2013 commercial fishery. Landings have consisted primarily of recruits since 2006.

The post-season survey suggests that the biomass available for the fishery and the percentage of intermediate-shell crabs will be higher in 2014 than in 2013.

The combined index of commercial CPUE and of NUE from the post-season survey is at its highest level.

The size of crabs caught in the commercial fishery has not varied much since 2011 and remains well above average. It should remain high in 2014 according to the post-season survey.

The post-season survey indicates above-average recruitment and abundance of adolescents  $\geq 78$  mm, suggesting continued high commercial biomass in the short term. According to the trawl survey conducted in the western part of the area, recruitment to the fishery could start to decrease in 2016.

The rise in the combined index resulting from the continued strong recruitment and the increase in residual biomass indicates that catches could be increased in 2014 without creating an excessively high harvesting intensity.

### Recommendation

For 2014, an increase in catches of 15% to 20% over those in 2013 would not result in an excessively high harvesting intensity.

## Area 15

### Description of the fishery

Area 15 has eight regular licences (with 91% of the TAC) as well as temporary allocations (with 9% of the TAC). The TAC was 593 t from 2008 to 2012, and then it peaked in 2013 at 652 t (Figure 15). The 2013 fishing season opened on April 1 and closed on July 7. The TAC was reached.

### Resource status in 2013

The standardized CPUE from the **commercial fishery** has been on the rise since 2003 and was well above average from 2006 to 2010. It then decreased to average in 2011 before increasing to well above average in 2012 and 2013 (Figure 16). Recruits (conditions 1 and 2), on an upward trend since 2009, dominated 2013 landings although there were still many intermediate-shell crabs (condition 3). The proportion of old crabs (conditions 4 and 5) was very small (Figure 17). The average size of legal-size crabs caught at sea has been well above average since 2007 although it decreased slightly to 111.8 mm in 2013 (Figure 18).



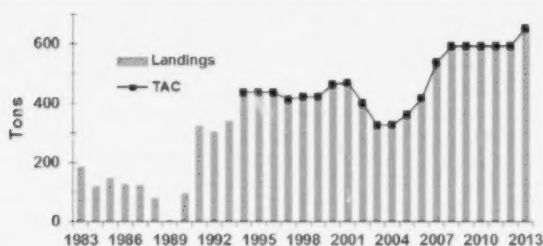


Figure 15. Landings and TAC in Area 15 from 1983 to 2013.

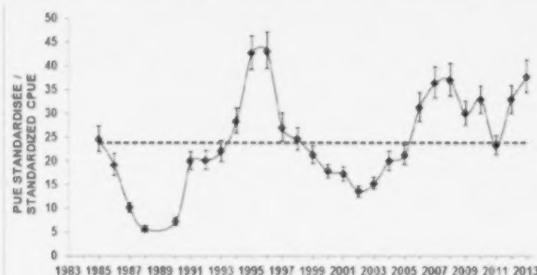


Figure 16. Standardized CPUE  $\pm$  confidence interval in the commercial fishery from 1985 to 2013 in Area 15. The dotted line shows the data series average.

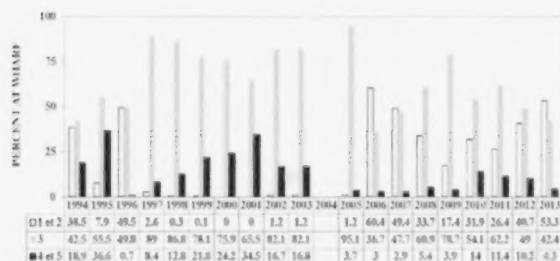


Figure 17. Carapace conditions for commercial crabs landed in Area 15 from 1994 to 2013.

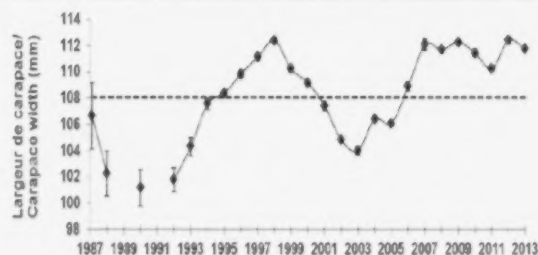


Figure 18. Average carapace width  $\pm$  confidence interval for commercial-size crabs sampled at sea from 1987 to 2013 in Area 15. The dotted line shows the data series average.

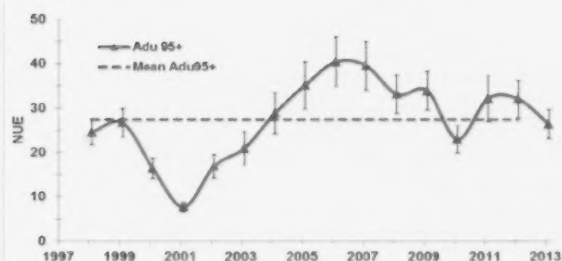


Figure 19. Catch rates (NUE), with confidence interval and average, of adult crabs  $\geq 95$  mm from the post-season survey in Area 15 from 1998 to 2013.

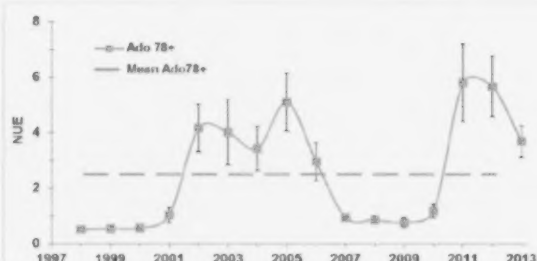


Figure 20. Catch rates (NUE), with confidence interval and average, of adolescent crabs  $\geq 78$  mm from the post-season survey in Area 15 from 1998 to 2013.

The trap-based research survey, conducted since 1998, shows that the NUE of adults  $\geq 95$  mm, which was above average in 2011 and 2012, decreased in 2013 to near average (Figure 19). The results of the post-season survey thus suggest that there will be less biomass available to the fishery at the beginning of the 2014 season than in 2013. The NUE of adolescent crabs  $\geq 78$  mm was high in 2011 and 2012 and, although it decreased in 2013, it remained well above average (Figure 20), suggesting, paradoxically, that recruitment will remain relatively high in the short term. The average size of adult crabs  $\geq 95$  mm increased from 2012 to 2013, suggesting that it will remain high in commercial catches in 2014.

As a result of commercial CPUE results and NUE results from the post-season survey that diverged, but were within a similar range, the **combined index** remained stable and relatively high from 2012 to 2013. This index suggests that there will be a similar amount of biomass available to the fishery in 2014 as there was in 2013.

### Conclusion and advice

The TAC increased by 10% to a peak of 652 t between 2012 and 2013, and it was reached.

The catch rate during the commercial fishery increased in 2013 and is well above average. Landings were dominated by a small majority of recruits.

The post-season survey suggests a decline in the fishery's performance in 2014.

The combined index of commercial CPUE and of NUE from the post-season survey remained stable.

The size of crabs caught in the commercial fishery decreased slightly, but remains high. It should remain high in 2014 according to the post-season survey.

The abundance index of adolescent crabs  $\geq 78$  mm in the post-season survey decreased in 2013, but has remained above average since 2011, suggesting good short-term recruitment.

The maintained combined index suggests that it will be possible to continue with the same harvesting level in 2014 as in 2013 without creating an excessively high harvesting intensity.

### Recommendation

For 2014, catches comparable to those of 2013 would not result in an excessively high harvesting intensity.

## Area 14

### Description of the fishery

Area 14 has 21 regular licences. The TAC decreased by 20% between 2010 and 2011, remained unchanged in 2012 and then increased by 10% to 448 t in 2013 (Figure 21). In 2013, the fishing season opened on April 28 and closed on August 3. The TAC was reached.

### Resource status in 2013

The standardized CPUE from the **commercial fishery** surged from 2007 to 2009, then decreased sharply to well below average in 2010. After remaining low and stable in 2011 and 2012, it increased in 2013 to slightly above average (Figure 22). Intermediate-shell crabs (condition 3) dominated landings from 2008 to 2012 although recruits (conditions 1 and 2) increased and became dominant in 2013. There was a very small proportion of old crabs (conditions 4 and 5) in 2013 (Figure 23). The average size of legal-size crabs caught at sea decreased from 2009 to 2012, but increased to 105.1 mm in 2013 although it remained below average (Figure 24).

The **trap-based research survey** conducted since 1996 indicates that the NUE of adults  $\geq 95$  mm was well below average from 2009 to 2011 before increasing sharply to well above average in 2012 and 2013. The abundance of intermediate-shell and old crabs (conditions 3, 4 and 5) was below average from 2009 to 2012, but increased to above average in 2013 (Figure 25), whereas the abundance of recruits (conditions 1 and 2) increased between 2009 and 2012 and remained very high in 2013 (Figure 26). The post-season survey results suggest that there will be more biomass available at the beginning of the 2014 season than in 2013 and that it will be primarily comprised of intermediate-shell crabs. The NUE for adolescents  $\geq 78$  mm has increased since 2010 and peaked in 2013, suggesting continued good short-term recruitment to the fishery (Figure 26). The average size of legal-size adult

crabs, which had been declining since 2008, remained stable but low in 2013, suggesting that the size of legal-size crabs caught in the commercial fishery will be just as low in 2014 as in 2013.

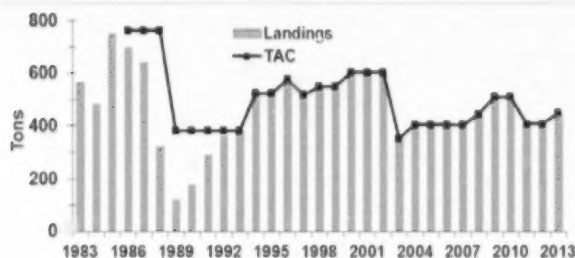


Figure 21. Landings and TAC in Area 14 from 1983 to 2013.

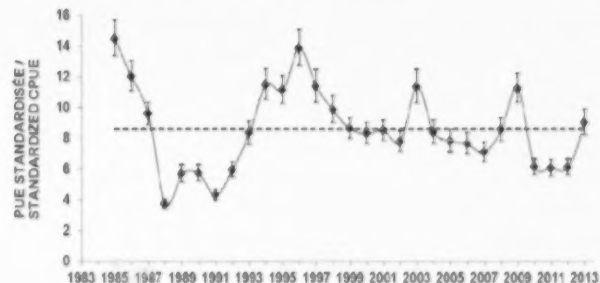


Figure 22. Standardized CPUE  $\pm$  confidence interval in the commercial fishery from 1985 to 2013 in Area 14. The dotted line shows the data series average.

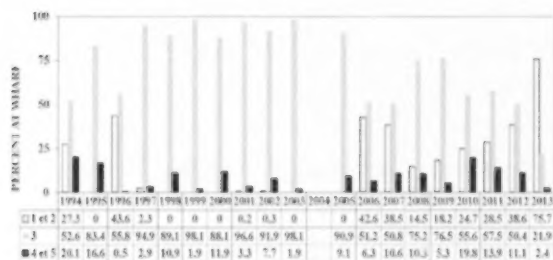


Figure 23. Carapace conditions for commercial crabs landed in Area 14 from 1994 to 2013.

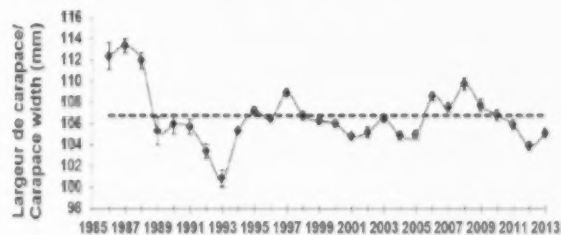


Figure 24. Average carapace width  $\pm$  confidence interval for commercial-size crabs sampled at sea from 1986 to 2013 in Area 14. The dotted line shows the data series average.

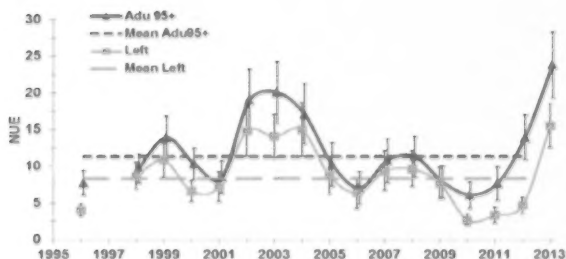


Figure 25. Catch rates (NUE), with confidence interval and average, of adult crabs  $\geq 95$  mm and those left by the fishery, from the post-season survey in Area 14 from 1996 to 2013.

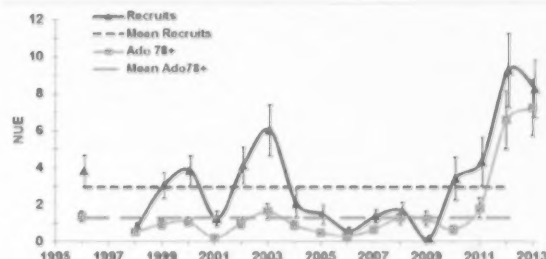


Figure 26. Catch rates (NUE), with confidence interval and average, of adolescent crabs  $\geq 78$  mm and recruits from the post-season survey in Area 14 from 1996 to 2013.

The combined index of commercial CPUE and of NUE from the post-season survey increased to a very high value. This index suggests that there will be more biomass available to the fishery in 2014 than there was in 2013.

### Conclusion and advice

The TAC increased by 10% to 448 t between 2012 and 2013 and it was reached.

The catch rate during the commercial fishery increased sharply in 2013 and is slightly above average. Landings largely consisted of recruits.

The post-season survey suggests that the biomass available for the fishery and the percentage of intermediate-shell crabs will be higher in 2014 than in 2013.

The combined index of commercial CPUE and of NUE from the post-season survey is at its highest level.

The size of crabs caught during the commercial fishery, which had been decreasing since 2009, increased slightly in 2013, but remains low. According to the post-season survey, it will likely remain low in 2014.

The post-season survey indicates that recruitment and abundance of adolescent crabs  $\geq 78$  mm are well above average, suggesting continued commercial biomass in the short term.

The rise in the combined index as a result of the continued good recruitment and the increase in residual biomass indicates that catches could be increased without creating an excessively high harvesting intensity.

### Recommendation

A maximum 35% increase in catches in 2014 over those in 2013 would not result in an excessively high harvesting intensity.

## Area 13

### Description of the fishery

Area 13 has 43 regular fishers from Quebec and 6 regular fishers from Newfoundland. The area was under a moratorium from 2003 to 2007 as a result of a marked decline in the biomass of legal-size crab. However, an index fishery with an annual TAC of 50 t was approved in 2003, 2004 and 2006. The area was reopened to the commercial fishery in 2008 with a TAC of 150 t for 2008 and 2009. The TAC was then set at 188 t for 2010 and 2011, 169 t for 2012 and 188 t for 2013 (Figure 27). Landings totalled 180 t in 2013. The fishing season opened on May 12 and closed on July 27.

### Resource status in 2013

The standardized CPUE from the **commercial fishery** was on a downward trend from 2008 to 2011. It remained low in 2012 before increasing in 2013 to above average (Figure 28). The area harvested since 2008 was relatively small compared to the total areas traditionally harvested and, in 2012 and 2013, the fishing effort was mostly concentrated in the south. Since 2008, intermediate-shell crabs (condition 3) have accounted for most of the crabs landed but, since 2010, the proportion of recruits (conditions 1 and 2) has increased, whereas the proportion of old crabs (conditions 4 and 5) has been decreasing (Figure 29). The average size of legal-size crabs caught at sea increased from 2010 to 2012 before decreasing in 2013 to 104.5 mm, which is slightly above the series average (Figure 30). It remains low compared to other areas of the northern Gulf of St. Lawrence.



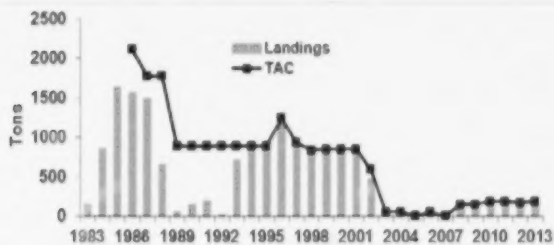


Figure 27. Landings and TAC in Area 13 from 1983 to 2013.

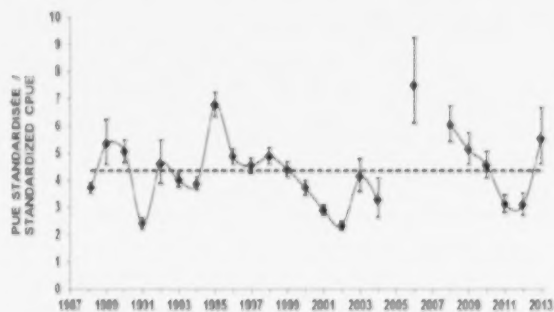


Figure 28. Standardized CPUE  $\pm$  confidence interval in the commercial fishery from 1988 to 2013 in Area 13. The dotted line shows the 1988-2013 data average.

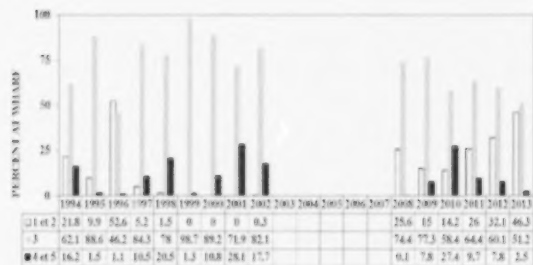


Figure 29. Carapace conditions for commercial crabs landed in Area 13 from 1994 to 2013.

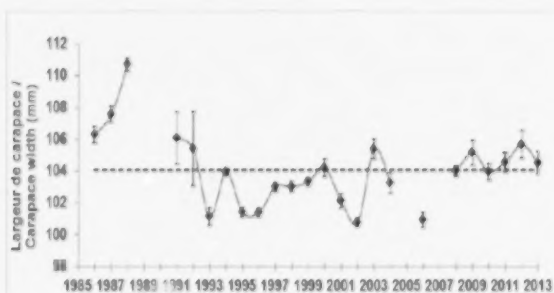


Figure 30. Average carapace width  $\pm$  confidence interval for commercial-size crabs sampled at sea from 1986 to 2013 in Area 13. The dotted line shows the data series average.

The trap-based research surveys conducted since 1999 show that the NUE of adults  $\geq 95$  mm peaked in 2008 and 2009 in the north, then decreased sharply until 2011 before increasing to above average and remaining at that level in 2012 and 2013 (Figure 31). For the south, the survey indicates that the NUE of adults  $\geq 95$  mm was high from 2006 to 2010 before decreasing to below average in 2011 and then increasing to well above average in 2012 and 2013 (Figure 32). The north and south surveys indicate that intermediate-shell and old crabs (conditions 3, 4 and 5) were the most abundant in the catches since 2006 (Figures 31 and 32), except in 2012 and 2013, where there was a high abundance of recruits in the north (Figure 33). In the south, recruits were abundant from 2004 to 2007, after which their numbers decreased and have remained at low values since 2008 despite a slight rise in 2013 (Figure 34). The average of the two surveys suggests that there will be more biomass available to the fishery at the beginning of the 2014 season than there was in 2013. The NUE of adolescent crabs  $\geq 78$  mm in the north reached its highest value in 2012 and then decreased to near average in 2013 (Figure 33). In the south, it increased slightly in 2013 but remained below average after dropping to the lowest value in the series in 2012 (Figure 34). In the post-season surveys, the average size of adult crabs in 2013 was similar to their size in 2012. It remained low in the north and relatively high in the south, suggesting that the size of crabs in the commercial fishery will be similar in 2014 to their size in 2013 if the distribution of the fishing effort remains the same.

The combined index of commercial CPUE and of NUE from the post-season surveys increased for the second consecutive year, but did not reach a very high value. This index suggests that there will be more biomass available to the fishery in 2014 than there was in 2013.

The 2012 trawl survey covering the northern part of Area 13 shows a sharp increase in recruits and in adolescent crabs between 78 mm and 95 mm, which is consistent with the post-season survey results.

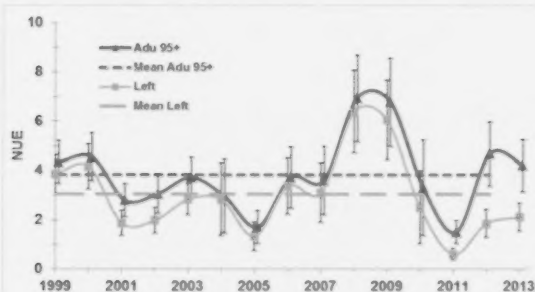


Figure 31. Catch rates (NUE), with confidence interval and average, of adult crabs  $\geq 95$  mm and those left by the fishery, from the post-season survey in Area 13 North from 1999 to 2013.

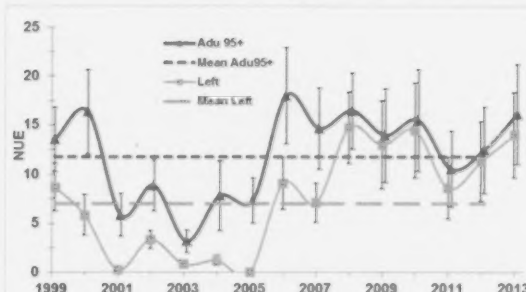


Figure 32. Catch rates (NUE), with confidence interval and average, of adult crabs  $\geq 95$  mm and those left by the fishery, from the post-season survey in Area 13 South from 1999 to 2013.

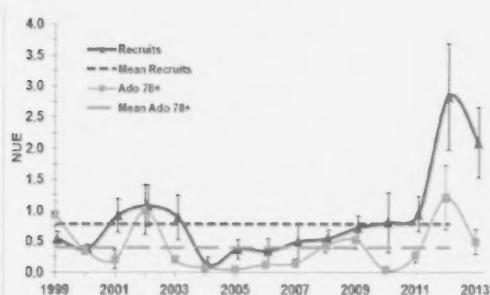


Figure 33. Catch rates (NUE), with confidence interval and average, of adolescent crabs  $\geq 78$  mm and recruits from the post-season survey in Area 13 North from 1999 to 2013.

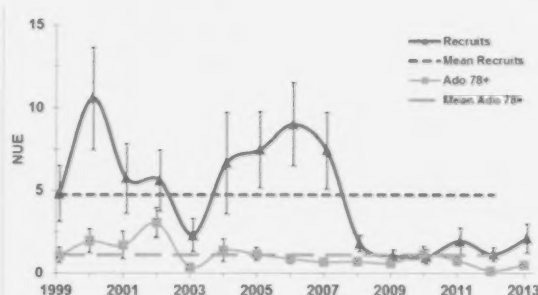


Figure 34. Catch rates (NUE), with confidence interval and average, of adolescent crabs  $\geq 78$  mm and recruits from the post-season survey in Area 13 South from 1999 to 2013.

### Conclusion and advice

The TAC increased by 11% to 188 t between 2012 and 2013. Landings were 180 t.

The commercial fishery catch rate increased in 2013 and is above the average for the years 1988 to 2012. The fishing effort was much higher in the southern part of the area. Landings consisted of a slight majority of intermediate-shell crabs and there has been a growing proportion of recruits since 2010.

The northern post-season survey suggests a slight decrease in biomass available to the fishery in 2014, whereas the southern post-season survey suggests an increase. Furthermore, if the fishing effort remains higher in the south, as it was in 2013, landings will still primarily consist of intermediate-shell crabs.

The combined index of commercial CPUE and of NUE from the post-season surveys increased.

The size of crabs caught in the commercial fishery decreased in 2013, but is slightly above average. According to the post-season surveys in the north and south, it will remain at a similar level in 2014.

The northern post-season survey indicates a decrease in recruitment and in adolescents  $\geq 78$  mm to a value that is still high in the case of recruits and slightly above average in the case of adolescents  $\geq 78$  mm. The southern post-season survey indicates a slight increase in recruits and in adolescents  $\geq 78$  mm, but to values that are still well below average.

The increase in the combined index suggests that catches can be increased without creating an excessively high harvesting intensity.

### **Recommendation**

A maximum 25% increase in catches in 2014 over the total authorized in 2013 would not result in an excessively high harvesting intensity.

## **Area 12A**

### **Description of the fishery**

Area 12A has 10 regular licences. The TAC dropped from 229 t in 2006 to 80 t in 2008 as a result of an overall decrease in commercial biomass abundance indices and, when the stock rebounded, it gradually increased to 174 t in 2013 (Figure 35). The 2013 fishing season opened on March 20 and closed on May 28. The TAC was reached.

### **Resource status in 2013**

**In the commercial fishery**, the standardized CPUE rose from the lowest value in the series in 2007 to well above average since 2011 and reached a record in 2013 (Figure 36). Annual landings since 2005 have consisted primarily of intermediate-shell crabs (condition 3). They accounted for a very high proportion in 2012 and 2013 compared to recruits (conditions 1 and 2). Old crabs (conditions 4 and 5) accounted for a very small proportion in 2013 landings (Figure 37). The size of legal-size crabs caught at sea has been above average since 2009 and at very high values since 2011, despite a decrease to 111.2 mm in 2013 (Figure 38).

**The trap-based research survey**, which started in 2000, was not conducted in 2013. It previously showed that the NUE of adults  $\geq 95$  mm increased in 2010 and 2011 to the highest values in the series before decreasing sharply in 2012. The number of intermediate-shell and old crabs (conditions 3 to 5) followed the same trend (Figure 39).

The NUE of recruits, which was well above average in 2010 and 2011, decreased sharply in 2012 to well below average (Figure 40). After being near or above the 2006-2011 historical average, the NUE for adolescents  $\geq 78$  mm decreased sharply and was well below average in 2012 (Figure 40), foreshadowing low recruitment.

Note that the abundance of crabs in Area 12A is partially determined by overflow from adjacent areas (17 to the west and 12 to the east).

### **Conclusion and advice**

The TAC increased by 7.5% to 174 t between 2012 and 2013 and it was reached.

The catch rate during the commercial fishery increased in 2013 and was well above average. Landings consisted primarily of intermediate-shell crabs.

There was no post-season survey in 2013 and, as a result, no available biomass or expected recruitment indices are available for 2014.

The size of crabs caught in the commercial fishery decreased in 2013, but remains well above average. In view of the lack of a post-season survey, the new proposed harvesting levels should be conservative.

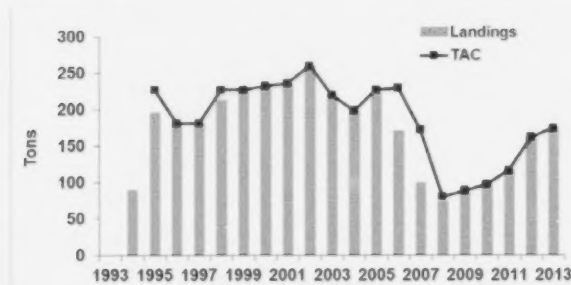


Figure 35. Landings and TAC in Area 12A from 1994 to 2013.

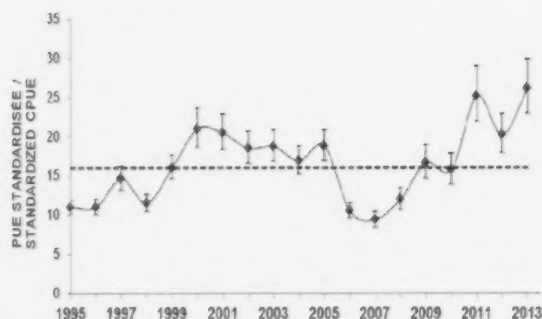


Figure 36. Standardized CPUE  $\pm$  confidence interval in the commercial fishery from 1995 to 2013 in Area 12A. The dotted line shows the data series average.

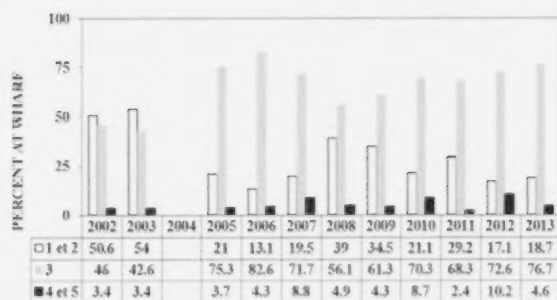


Figure 37. Carapace conditions for commercial crabs landed in Area 12A from 2002 to 2013.

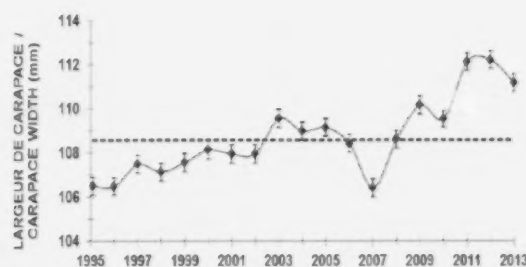


Figure 38. Average carapace width  $\pm$  confidence interval for commercial-size crabs sampled at sea from 1995 to 2013 in Area 12A. The dotted line shows the data series average.

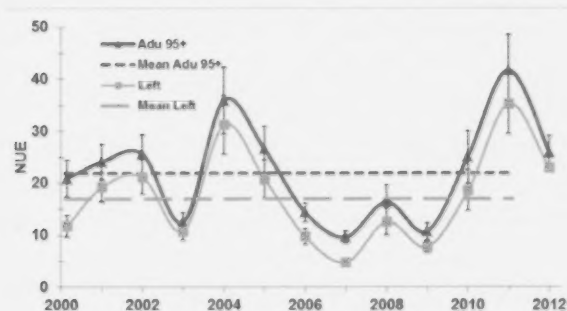


Figure 39. Catch rates (NUE), with confidence interval and average, of adult crabs  $\geq 95$  mm and those left by the fishery, from the post-season survey in Area 12A from 2000 to 2012.

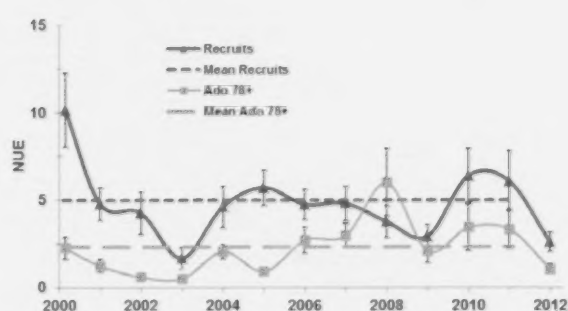


Figure 40. Catch rates (NUE), with confidence interval and average, of adolescent crabs  $\geq 78$  mm and recruits from the post-season survey in Area 12A from 2000 to 2012.



### Recommendation

Based on the commercial catch rate, a maximum 10% increase in catches in 2014 over those in 2013 would not result in an excessively high harvesting intensity.

### Area 12B

#### Description of the fishery

Area 12B has eight regular licences. The TAC gradually rose from 246 t in 2010 to 390 t in 2013 (Figure 41). The 2013 fishing season opened on March 22 and closed on June 21. The TAC was reached.

#### Resource status in 2013

The standardized CPUE from the **commercial fishery** was below average from 2003 to 2009 and then increased to well above average since 2010. In 2013, it was at the highest value in the series (Figure 42). Annual landings since 2005 have consisted primarily of intermediate-shell crabs (condition 3) and the proportion of recruits (conditions 1 and 2) has decreased considerably since 2011. Old crabs account for a small proportion of landings (Figure 43). The average size of legal-size crabs caught at sea has been on the rise since 2010 and has been well above average at 110 mm since 2012 (Figure 44).

The **trap-based research survey** conducted since 2001 (except in 2005) shows that the NUE of adults  $\geq 95$  mm remained below average from 2003 to 2010 before increasing sharply to well above average in 2013 (Figure 45). The number of intermediate-shell and old crabs (conditions 3 to 5) in the catches followed the same trend, specifically with a sharp increase in the last 3 surveys. The number of recruits (conditions 1 and 2) was very high in 2009 and 2010 before decreasing sharply in 2011 and then increasing until 2013 to slightly above average (Figure 46). Biomass available at the beginning of the 2014 season could therefore be above 2013 levels and would likely consist primarily of intermediate-shell crabs. The NUE of adolescents  $\geq 78$  mm has been slightly above average since 2011, foreshadowing continued short-term recruitment (Figure 46). The average size of legal-size adults was smaller in the 2013 survey than in the 2012 survey, but remains high, suggesting that crabs will be large during the 2014 fishing season.

The **combined index** of commercial CPUE and of NUE from the post-season survey increased and was at its highest value in 2013. This index suggests that there will be more biomass available to the fishery in 2014 than there was in 2013.

#### Conclusion and advice

The TAC increased by 20% to 390 t between 2012 and 2013 and was reached.

The catch rate during the commercial fishery increased, reaching the highest value in the series. Landings consisted primarily of intermediate-shell crabs.

The post-season survey suggests that the biomass available for the fishery and the percentage of intermediate-shell crabs will be higher in 2014 than in 2013.

The combined index of commercial CPUE and of NUE from the post-season survey is at its highest level.

The size of crabs caught during the commercial fishery remained stable and well above average in 2012 and 2013. It could decrease in 2014, based on the post-season survey, but it should still remain high.

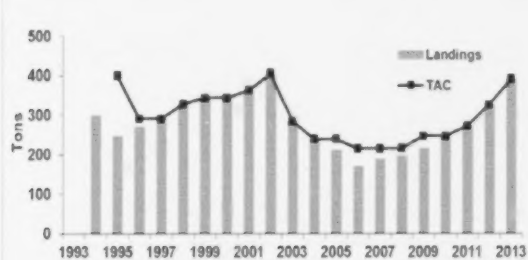


Figure 41. Landings and TAC in Area 12B from 1994 to 2013.

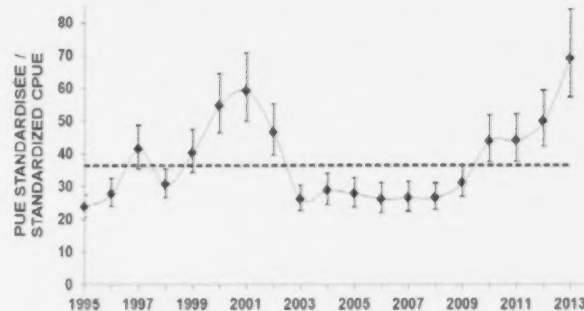


Figure 42. Standardized CPUE  $\pm$  confidence interval in the commercial fishery from 1995 to 2013 in Area 12B. The dotted line shows the data series average.

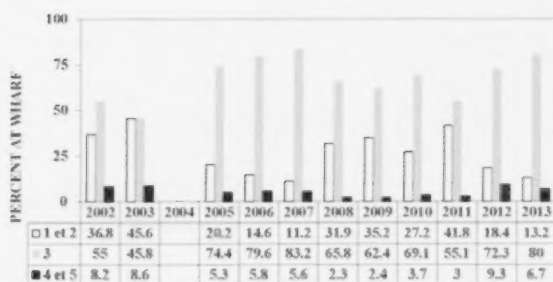


Figure 43. Carapace conditions for commercial crabs landed in Area 12B from 2002 to 2013.

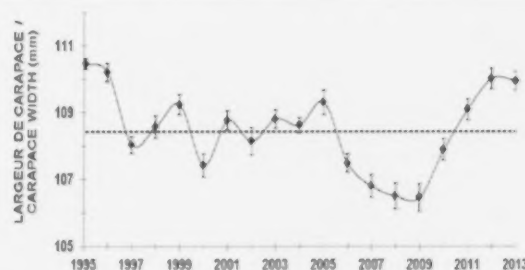


Figure 44. Average carapace width  $\pm$  confidence interval for commercial-size crabs sampled at sea from 1995 to 2013 in Area 12B. The dotted line shows the data series average.

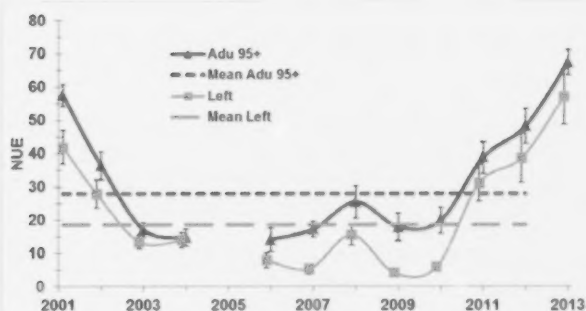


Figure 45. Catch rates (NUE), with confidence interval and average, of adult crabs  $\geq 95$  mm and those left by the fishery, from the post-season survey in Area 12B from 2001 to 2013 (except for 2005).

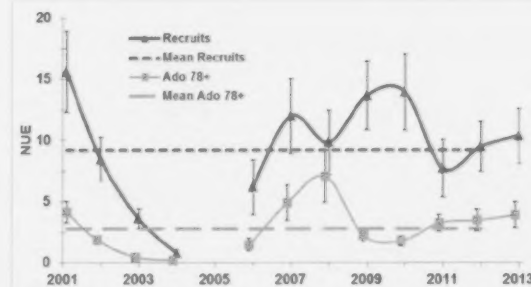


Figure 46. Catch rates (NUE), with confidence interval and average, of adolescent crabs  $\geq 78$  mm and recruits from the post-season survey in Area 12B from 2001 to 2013 (except for 2005).

The post-season survey indicates above-average recruitment and abundance of adolescents  $\geq 78$  mm, suggesting continued high commercial biomass in the short term.

The rise in the combined biomass index resulting from the maintained recruitment and the increase in residual biomass indicates that catches can be increased without creating an excessively high harvesting intensity.

### Recommendation

For 2014, a 20% to 25% increase in catches over those in 2013 would not result in an excessively high harvesting intensity.

## Area 12C

### Description of the fishery

Area 12C includes two banks (north and south sectors) separated by the deep channel of the Jacques-Cartier Strait. There are 5 regular licences, as well as some temporary allocations. The annual TAC was 320 t from 2008 to 2012, after which it increased in 2013 by 10% to 352 t (Figure 47), including the temporary allocations (110 t in 2013). The fishing season opened on April 8 and closed on July 14. The TAC was reached.

### Resource status in 2013

In the commercial fishery, the standardized CPUE was high in 2008, but then decreased until 2011 before increasing slightly to near the average in 2012 and 2013 (Figure 48). The fishing effort was mainly concentrated in the northern section of the area. Recruits (conditions 1 and 2), which had been on the rise since 2011, accounted for most of the crabs landed in 2013, while landings had largely consisted of intermediate-shell crabs (condition 3) from 2008 to 2012. Landings contained a very small proportion of old crabs (Figure 49). The average size of legal-size crabs caught at sea decreased from 2008 to 2013 to 108.6 mm or below average (Figure 50).

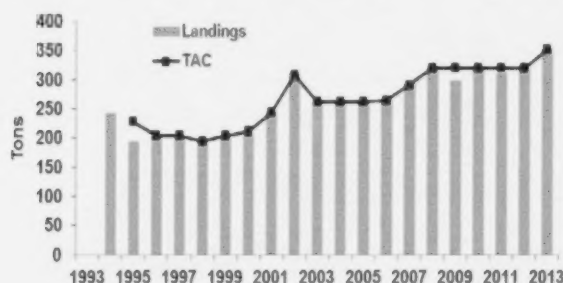


Figure 47. Landings and TAC in Area 12C from 1994 to 2013.

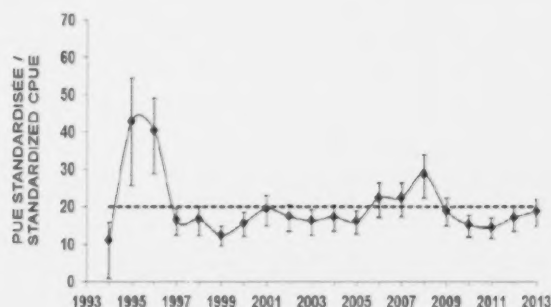


Figure 48. Standardized CPUE  $\pm$  confidence interval in the commercial fishery from 1994 to 2013 in Area 12C. The dotted line shows the data series average.

The trap-based research survey, conducted since 2000, shows that the NUE of adults  $\geq 95$  mm, which had been trending upward since 2010, decreased in 2013 to a low value (Figure 51). The number of intermediate-shell and old crabs (conditions 3 to 5) reached the lowest value in the series in 2011 before increasing in 2012 and then decreasing again in 2013 to well below average (Figure 51). Conversely, the abundance of recruits (conditions 1 and 2) and of adolescents  $\geq 78$  mm, which had reached the highest values in the series in 2011, decreased in 2012 and 2013 to values that nevertheless remained near average (Figure 52). The survey results suggest that there will be less biomass available at the start of the 2014 fishing season than in 2013. The average size of legal-size

adult crabs has been decreasing slightly since 2008, suggesting that it could continue to do so in the 2014 fishery.

The combined index of commercial CPUE and of NUE from the post-season survey decreased slightly in 2013. This index suggests that there will be less biomass available to the fishery in 2014 than in 2013.

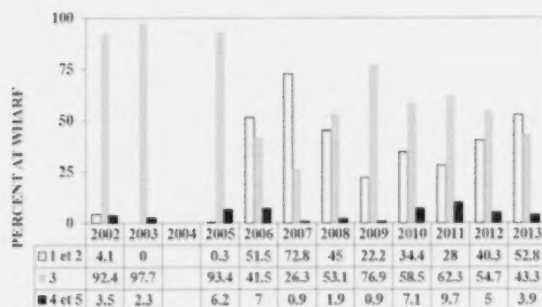


Figure 49. Carapace conditions for commercial crabs landed in Area 12C from 2002 to 2013.

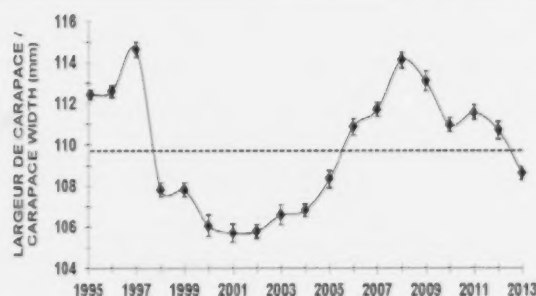


Figure 50. Average carapace width  $\pm$  confidence interval for commercial-size crabs sampled at sea from 1995 to 2013 in Area 12C. The dotted line shows the data series average.

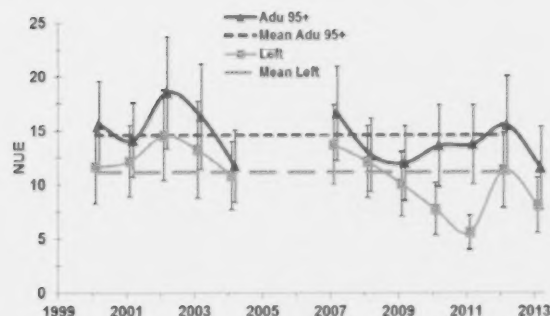


Figure 51. Catch rates (NUE), with confidence interval and average, of adult crabs  $\geq 95$  mm and those left by the fishery, from the post-season survey in Area 12C from 2000 to 2013 (except for 2005 and 2006).

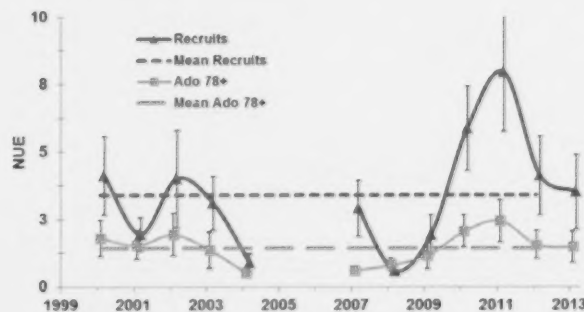


Figure 52. Catch rates (NUE), with confidence interval and average, of adolescent crabs  $\geq 78$  mm and recruits from the post-season survey in Area 12C from 2000 to 2013 (except for 2005 and 2006).

### Conclusion and advice

The TAC increased by 10% to a new peak of 352 t between 2012 and 2013 and it was reached.

The catch rate during the commercial fishery increased slightly in 2013 and was near average. Landings were dominated by a small majority of recruits.

The post-season survey suggests that the biomass available for fishing in 2014 will be lower than it was in 2013 and that the catches will consist largely of intermediate-shell crabs.

The combined index of commercial CPUE and of NUE from the post-season survey decreased.

The size of crabs caught during the commercial fishery in 2013 decreased to below average. According to the post-season survey, it will likely remain low in 2014.



The post-season survey indicates a slight decrease in recruitment and stable abundance of adolescents  $\geq 78$  mm, both of which are near average.

The decline in the combined index suggests that there should be no increase in catches in 2014 to avoid creating an excessively high harvesting intensity.

### **Recommendation**

For 2014, catches equal to or 10% lower than those in 2013 would not result in an excessively high harvesting intensity.

## **Area 16A**

### **Description of the fishery**

Area 16A includes two banks (north and south sectors) separated by the deep channel of the Jacques-Cartier Strait. Since 2002, it has been accessible to the 43 Quebec fishers holding a Snow Crab fishing licence for Area 13. The TAC was 426 t from 2009 to 2012, and then increased by 10% to 468 t in 2013 (Figure 53). It was reached. The fishing season opened on April 7 and closed on July 13.

### **Resource status in 2013**

The standardized CPUE from the **commercial fishery** peaked in 2008, but then decreased until 2010 to below average before gradually increasing to near average in 2013 (Figure 54). An increase in fishing effort in the southern section since 2010 resulted in a better distribution of fishing pressure between the north and south than in previous years. Recruits (conditions 1 and 2), which have been on the rise since 2011, accounted for the majority of crabs landed in 2013, whereas intermediate-shell crabs (condition 3) accounted for the majority of crabs landed from 2008 to 2012 (Figure 55). Old crabs (conditions 4 and 5), which accounted for nearly 20% of crabs landed in 2010 and 2011, decreased significantly in 2012 and 2013 (Figure 55). The average size of legal-size adult crabs caught at sea decreased from 2008 to 2011, then increased sharply in 2012 and slightly in 2013 to 112.2 mm (Figure 56).

**The trap-based research survey**, conducted since 2002, showed an upward trend in NUE starting in 2009, when it was well below average, to well above average in 2012, after which it decreased to near average in 2013 (Figure 57). The number of intermediate-shell and old crabs (conditions 3 to 5) dropped to the lowest value in the series in 2011 before increasing to near average in 2012 and then decreasing in 2013 (Figure 57). Conversely, recruits (conditions 1 and 2) reached the highest values in the series in 2011 and remained at high values in 2013 (Figure 58). The abundance of adolescents  $\geq 78$  mm also reached its highest value in 2011 before decreasing to near average in 2013 (Figure 58). According to the trap survey, the commercial biomass available to the fishery at the beginning of the 2014 season will be slightly lower than in 2013, and landings will consist of similar proportions of recruits and intermediate-shell and old crabs. The average size of adult crabs  $\geq 95$  mm has been on the rise since 2011, suggesting that crabs to be landed in the 2014 fishing season will remain large.

**The combined index** of commercial CPUE and of NUE from the post-season survey remained comparable in 2013 to its level in 2012, suggesting that there will be a similar amount of biomass available to the fishery in 2014 as in 2013.

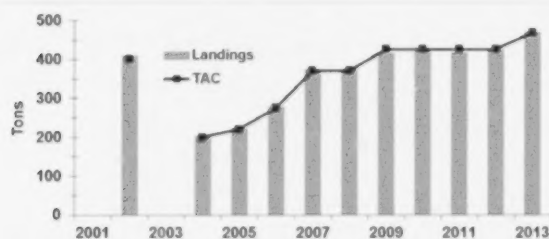


Figure 53. Landings and TAC in Area 16A from 2002 to 2013.

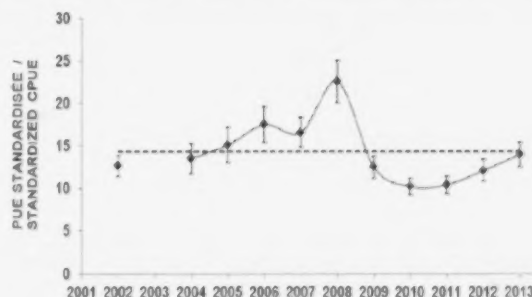


Figure 54. Standardized CPUE  $\pm$  confidence interval in the commercial fishery from 2002 to 2013 in Area 16A. The dotted line shows the data series average.

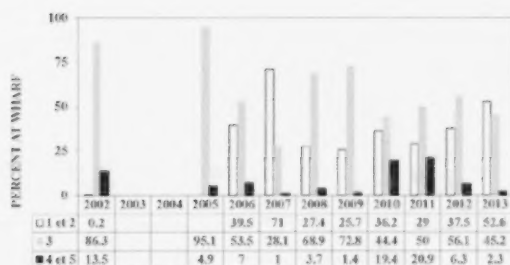


Figure 55. Carapace conditions for commercial crabs landed in Area 16A from 2002 to 2013.

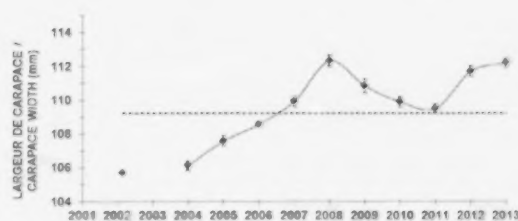


Figure 56. Average carapace width  $\pm$  confidence interval for commercial-size crabs sampled at sea from 2002 to 2013 in Area 16A. The dotted line shows the data series average.

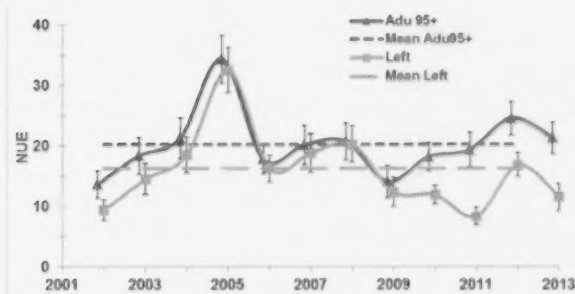


Figure 57. Catch rates (NUE), with confidence interval and average, of adult crabs  $\geq 95$  mm and those left by the fishery, from the post-season survey in Area 16A from 2002 to 2013.

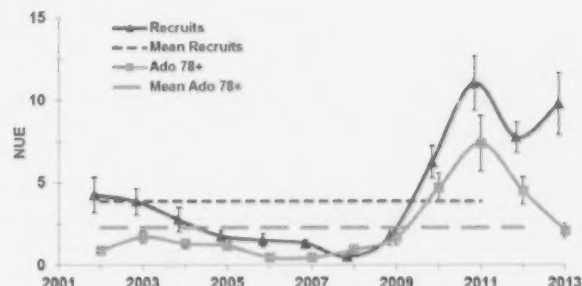


Figure 58. Catch rates (NUE), with confidence interval and average, of adolescent crabs  $\geq 78$  mm and recruits from the post-season survey in Area 16A from 2002 to 2013.

### Conclusion and advice

The TAC increased by 10% and peaked at 468 t between 2012 and 2013. It was reached.

The commercial catch rate increased in the 2013 fishery to near average. Landings were dominated by a small majority of recruits.

The post-season survey suggests that there will be slightly less biomass available to the fishery in 2014 than in 2013 and that landings will consist of similar numbers of recruits and intermediate-shell crabs.

The combined index of commercial CPUE and of NUE from the post-season survey remained comparable in 2014 to its 2013 level.

The size of crabs caught in the commercial fishery increased slightly and is well above average. It should remain high in 2014 according to the post-season survey.

The post-season survey indicates a high abundance of recruits and a decrease in the abundance of adolescent crabs  $\geq 78$  mm to near average.

The stability of the combined index indicates that catches can remain at the same level as in 2013 without creating an excessively high harvesting intensity.

### **Recommendation**

For 2014, catches comparable to those in 2013 would not result in an excessively high harvesting intensity.

### **Sources of Uncertainty**

The quality of science advice depends mainly on the accuracy of the parameters obtained through sampling and the subsequent analyses. Information obtained from logbooks and purchase slips during the fishing season affects the accuracy of the parameters derived from these documents. For instance, abundance indices and fishing effort calculations obtained from logbooks may include errors that will affect the science advice provided. The selectivity and catchability of traps can vary depending on the type of trap used, its volume and the size of the mesh covering the trap, the amount and quality of bait used and soak time, which can vary with the fishing strategies employed and prevailing environmental conditions. The catchability of adolescent crabs and recruits can also be affected by the abundance of intermediate-size adult crabs (condition 3) on the seafloor. The selective sorting of catches can also affect the quality of the data obtained.

The abundance and condition indices and the estimates of crab size obtained from the trawl and trap surveys depend on the type of gear used and are affected by uncertainties related to catchability variations in the different crab groups targeted. Some types of fishing gear are better suited to given seafloor areas than other types and this factor influences the spatial coverage ultimately sampled. The biological characteristics specific to Snow Crabs can also create sources of uncertainty that impinge on the science advice. For instance, the terminal moulting phase, which occurs at various sizes, will affect crab condition and catchability. Natural mortality can also vary with the life stage and condition of the crabs.

## SOURCES OF INFORMATION

This Science Advisory Report is from the February 17 and 18, 2014 meeting on the Assessment of the Estuary and northern Gulf of St. Lawrence Snow Crab stocks. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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